1. Electrostrictive phonon generation

a) You are using a 200 fs Gaussian 1030 nm pump beam (10 µJ per pulse) to excite electrostrictive phonons into SiO_2 (glass). What is the approximate (order of magnitude) stress amplitude of the generated phonons? Indicate the assumptions you made.

b) Using the same beam, you excite thermoelastic phonons into gold. What is the approximate stress amplitude of the generated thermoelastic phonons?

2. Phonon generation mechanisms

According to Gamaly and Rode, Prog. Quant. El. **37**, 2013, the atomic volumetric forces during an ultrafast pulse excitation are given as

$$f_i = \frac{\partial \sigma_{ik}}{\partial x_k} = -\frac{\partial P}{\partial x_k} + \frac{\partial \varepsilon_{ik}^{(p)}}{\partial x_k}\frac{E^2}{8\pi} + \frac{(\varepsilon_D - 1)}{8\pi}\frac{\partial E^2}{\partial x_i} = f_i^{th} + f_i^{(p)} + f_i^{pond}$$

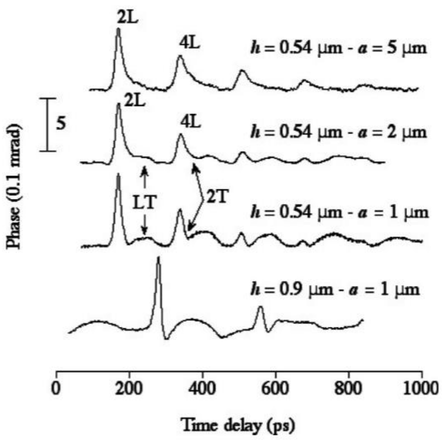
Describe the forces, their timescales and their approximate magnitudes when one excites aluminium at a fluence of 10 mJ/cm^2 with an 20 fs, 820 nm pump beam.

3. Pump-probe experiment

You are making a pump-probe experiment. Draw the schematic of the experimental device. How do the features of the different components affect the measurement? What sample properties do you have to take into account?

4. Measuring aluminium

A paper by Rossignol *et al*. (PRL 2005) describes experiments to generate longitudinal and shear CAPs in aluminum. They obtained the following results:



Describe the echoes. Calculate the speeds of sound, and the corresponding mechanical properties (moduli).